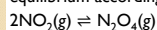


Le Châtelier's Principle

Problem

A 1.00 mol sample of $\text{N}_2\text{O}_4(\text{g})$ is placed in a 10.0 L vessel and allowed to reach equilibrium according to the equation:



Calculate the equilibrium concentrations of: $\text{N}_2\text{O}_4(\text{g})$ and $\text{NO}_2(\text{g})$.

$$K_c = 4.00 \times 10^{-4} \text{ at } 25^\circ \text{C}$$

Now calculate the equilibrium concentration if instead you had 1.00 mol of NO_2 and no N_2O_4 .

Le Châtelier's Principle

- ~whenever stress is applied to a system at equilibrium, a new equilibrium will be obtained to relieve this stress.
- This will "shift" the equilibrium to the right or left.

Le Châtelier's Principle

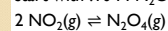
- A stress is a change in temperature, pressure, or concentration of some component.
- This will change the rate of reaction of either the forward or backward reaction
- So you will see an increase in the concentration of the substances on one side of the equation, and a decrease on the other.

Effects of Changes on the System

1. Concentration: The system will shift away from the added component. If a component is removed, the opposite effect occurs.
2. Temperature: K will change depending upon the temperature (endothermic – treat heat energy like a reactant; exothermic – treat heat energy like a product).

Redo Problem

What happens if we heat or cool our earlier problem? The K changes because the equilibrium concentration with change. Still start with .10 M N_2O_4 .



Calculate the equilibrium concentrations of: $\text{N}_2\text{O}_4(\text{g})$ and $\text{NO}_2(\text{g})$.

$$K_c = 2.9 \times 10^{-5} \text{ at } 100^\circ \text{C}$$

$$K_c = 2.6 \times 10^{-2} \text{ at } 0^\circ \text{C}$$

$$K_c = 570 \text{ at } -75^\circ \text{C}$$

Effects of Pressure Changes on the System

3. Pressure:
 - a) The system will shift away from the added gaseous component. If a component is removed, the opposite effect occurs.
 - b) Addition of inert gas does not affect the equilibrium position.
 - c) Decreasing the volume shifts the equilibrium toward the side with fewer moles of gas.

Problem

- In a study of the chemistry of glass etching, an inorganic chemist examines the reaction between sand (SiO_2) and hydrogen fluoride at high temperature:
$$\text{SiO}_2(\text{s}) + 4\text{HF}(\text{g}) \rightleftharpoons \text{SiF}_4(\text{g}) + 2\text{H}_2\text{O}(\text{g})$$
- Predict the effect on $[\text{SiF}_4]$ when
 - a) $\text{H}_2\text{O}(\text{g})$ is removed
 - b) some water is added at 220°C
 - c) some HF is removed
 - d) some sand is removed.

More

- How would you change the pressure (via a change in volume) of the following reaction mixtures to decrease the yield of products?
 - $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$
 - $\text{CaC}_2\text{O}_4(\text{s}) \rightleftharpoons \text{CaCO}_3(\text{s}) + \text{CO}(\text{g})$
 - $4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightleftharpoons 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{g})$

Last one

• How would a decrease in temperature affect the partial pressure of the underlined substance and K_p for the following reactions?

